

cross-section of a stem four years old, in which only two of the wings show the furrow, owing to the fact that at the point where this section was cut, the furrows of the remaining three wings were not perfectly developed. As the pheloderm plays no important part in the formation of cork from the standpoint of our subject, no attention was given to this throughout the study made.

Philadelphia, Penn.

Characteristic vegetation of the North American desert.

DR. GEORGE VASEY.

The term desert has a somewhat wide application. In one sense it is applied to a tract of country practically destitute of vegetation from sterility of soil. Such sterility, however, is not always the fault of the soil, but is due to the absence of water in sufficient quantity to promote vegetation. Our ideas of a desert are largely drawn from popular descriptions of some portions of the Great Sahara, where low plains covered with drifting sand, interspersed with vast fields of naked rock, spread over regions over which the traveler might pass for days without meeting with a drop of water or a blade of grass. Such cases are met with, but then occasionally an oasis is met an island of verdure, where, around cool springs of water, flourishes a tropical vegetation of palms, ferns and acacias. But this description covers only a part of what is known as the Sahara Desert.

Explorations of travelers and scientists show that the great desert is a region of elevated plains rising up into mountains of 300 to 500 feet in height, and separated from each other by valleys, immense sandy tracts at a general elevation of from 1,200 to 1,500 feet, but sinking at times into depressions which sometimes descend below the level of the sea.

The moisture from the Mediterranean Sea is arrested in its southward passage by the range of mountains running nearly parallel with it, and is mainly precipitated on the north or Mediterranean side; thus the southern slopes are left in an arid condition, the aridity increasing as the country recedes from the mountain ranges and peaks, where snow falls in the winter, and, melting in the summer, runs down the narrow courses and ravines until it is finally wasted in

the sands of the desert. Similar causes, as is well known, operate in our own country for the production of our arid districts, particularly in what is called the Great Basin. A few years ago it was the custom to speak of the country now embraced in the states of Kansas, Nebraska and New Mexico as the Great American Desert.

A large portion of this country, although blessed with but a limited rain-fall, proves to be capable of remunerative cultivation.

There are some stretches of loose, sandy soil supporting only a sparse vegetation of Chenopodiaceous shrubs and coarse grasses, but these are of limited extent.

It is to the strip of country lying at the eastern base of the Sierra Nevada range of mountains, and at the south where this range breaks down into high and extensive plateaus in Arizona and southeastern California, that we find our nearest approach to a true desert, and to this region our remarks will, for the most part, be confined. For a general description of the physical features of this region I shall avail myself of many of the observations of Mr. Sereno Watson, as given in his report of the botany of the 40th parallel.

In the northern part of this district the basin extends from the base of the Sierras eastward to the Wahsatch Mountains, a distance of over 400 miles. This span is occupied mainly by numerous short and isolated and minor ranges, having a general north and south trend, and at an average distance of about twenty miles. The bases of these ranges are usually very narrow, even in the most elevated rarely exceeding eight or ten miles in breadth, the slopes abrupt and the lines of foot-hills contracted, the mesas grading at a low and uniform angle into the broad interrupted valleys. Over the larger portion of the territory, especially in Nevada, the combined areas of the valleys and the areas occupied by the mountains are very nearly equal. The greater portion of the basin at this point is drained by the Humboldt River, which traverses the territory from northeast to southwest, and terminates in Humboldt Lake, which has no outlet. The other smaller streams of the region likewise lose themselves at other points in the main depression of the basin at an altitude of about 3,800 feet above the sea. The mountain ranges of the basin vary in altitude from 1,000 to 6,000 feet above the valleys.

“They are cut up by numerous ravines or cañons, which

are narrow, very rarely with an acre of interval or surface approaching to a level, the sides sometimes rocky or precipitous, more frequently sloping to the summits of the lateral ridges. With few exceptions, also, these mountains are for most of the year destitute of water, with but small rivulets in the principal cañons, frequently with only scant streams here and there at their bases, irrigating a few square yards of ground. Even where the mountain supply is sufficient to send a stream into the valleys, it is usually either soon entirely evaporated, sinks into the porous soil, or becomes demoralized with alkali and is lost in the mud of the plain."

The amount of rain-fall in this region is not definitely known. "It varies greatly with the altitude, and is probably considerably more upon the eastern slope of the mountains than upon the western. Though any statement of the average annual amount must be largely conjectural, yet it may be roughly estimated at eighteen inches, of which one-half may be considered as falling between April and November, inclusive." "No portion of this district, however desert in repute and in fact, is destitute of some amount of vegetation, even in the driest seasons, excepting only the alkali flats, which are usually of quite limited extent. Even these have frequently a scattered growth of *Sarcobatus* or *Halo-stachys* surmounting isolated hillocks of drifted sand compacted by their roots and buried branches." With these in alkaline soils are usually combined several other *Chenopodiaceous* plants, such as *Salicornia herbacea*, several species of *Suæda*, *Kochia prostrata*, *Eurotia lanata*, *Grayia polygaloides*, *Schoberia occidentalis*, and several species of *Atriplex*. In addition, there are two species of *Thelypodium*, three of *Cleomella*, one of *Astragalus*, two species of *Aplopappus*, one *Crepis*, one *Cressa*, *Lycium Andersoni*, *Erythraea Nuttallii*, and of grasses chiefly *Distichlis maritima*, *Spartina gracilis* and *Sporobolus asperifolius*. There is an almost universal absence of trees. In the valleys of the Humboldt, Truckee and Carson Rivers, *Populus monilifera* and *P. trichocarpa* are found sometimes in considerable numbers. Several shrubs besides those mentioned above, sometimes mingled with those in alkaline soils, as the "everlasting sage-brush," *Artemisia tridentata*, and the similar, but smaller, *Artemisia trifida*. These are often accompanied by *Bigelovia graveolens*, called broom-sage, and *Tetradymia canescens*, and along the fresh water streams two species of shrubby willows. On the foot-hills only is found the shrubby

Purshia tridentata. "The mountains are, in a large measure, as destitute of trees as the valleys, or even more naked, from the dwarfed character of the shrubs upon the exposed ridges and summits."

On the higher ranges a sparse supply of *Pinus monophylla*, the nut pine, with two or three species of *Juniperus*, or red cedars, is to be found. The mountain mahogany, *Cercocarpus ledifolis*, is of frequent occurrence on high ranges at an altitude of 6,000 or 8,000 feet.

Mr. Watson gives a list of the peculiarly desert species of the northern portion of the basin, amounting to 305, of which about one-third are strictly confined to the basin, quite a large number of which are southern and have extended up from the desert portions of Arizona and southeastern California. Going southward, the desert district by the trend of the Sierras is deflected eastward, and in the southern part of Nevada the Rio Virgin and its branches are reached, where the drainage of the country is to the Colorado River. A little further south, the Mohave River, coming in from the west, traverses the desert region of southeastern California. Crossing the Colorado into Arizona, we find that entire state and the western portion of New Mexico drained by the Little Colorado and the Gila Rivers, having their origin and affluents in various mountain ranges, some of which rise to 10,000 to 11,500 feet altitude, furnishing above 6,000 feet exclusive forests of pine, spruce and cedar. At elevations of 6,000 feet several species of oak and other deciduous trees are sparsely spread over the mountain declivities. The country then descends into broken plains, or in some places, particularly in the northern portions bordering the Colorado, into extensive plateaus. Over a large portion of the state these plains afford a scanty supply of grasses and small shrubs which give support to thousands of cattle, but often they become dreary stretches of barren, sandy soil entirely destitute of water for distances of from twenty to fifty miles. The vegetation of these plains and mountain slopes becomes very peculiar and striking. I will quote a few paragraphs from Dr. J. T. Rothrock in his description of this remarkable region. He says: "Crossing a series of mesa lands at an elevation of 6,000 to 7,000 feet, we begin the descent to the parched, superheated valley of the Gila River. A complete change comes over the flora. If verdure and superabundant vitality were the expression of the plant life on the timber-clad Mogollon mesa, in the valley of the Gila, hardness of texture

and contraction of form would be characteristic of the flora. The attempt to make an analysis of one's feelings on being somewhat unexpectedly brought face to face with this peculiar vegetation would be futile, as no point of comparison appears to offer. The giant *Cereus* occupies the hill-sides which have a southern and southeastern exposure, towering up to a height of from thirty to fifty feet. *Fouquieria*, with the leafless, wand-like trunk, and its tips of scarlet flowers; *Agave Palmeri* and *Agave Parryi*, and various species of *Dasyliirion*, dry, rigid skeletons of plants without the living green; *Canotia*, a tree twenty feet high, a foot in diameter, with green branches provided with stomata, but no leaves, all go to complete this desolate floral landscape, white with *Mimosa*. *Acaciæ* and *Calliandræ*, rising to the dignity of trees or dwarfed to mere underbrush, inhabit the dry hill-sides and ravines, but still by their small leaves and hardened tissues show that they, too, have the impress of the dry, hot air about them." One of the most conspicuous of the desert shrubs is *Larrea Mexicana*, commonly called creosote-bush, which has a strong aromatic fragrance, plainly perceptible in the air, and exuding a reddish-brown resinous matter on the branches. It is reputed to have strong medicinal virtues. Several kinds of Rhamnaceous shrubs also are frequently met with, among them species of *Zizyphus* and *Karwinskia*. The order Leguminosæ has a pretty abundant representation in peculiar species in the desert region, particularly the genera *Astragalus*, *Galea*, *Cassia*, *Acacia* and *Mimosa*.

The mesquit tree, *Prosopis juliflora*, extends through the dry regions from Texas to southern California, sometimes becoming a tree of from thirty to forty feet high, and forming dense thickets, more commonly a mere bush, bearing freely bean-like pods, which are valuable forage for mules and horses while making hard marches. The wood is frequently the main dependence for fuel. Several thorny shrubs of the genus *Parkinsonia*, with smooth, light-green bark, and small, scant leaves, but conspicuous contracted pods, form a common feature of the landscape. But the most abundant and characteristic plants of the desert region are the many genera and species of Cactaceæ, varying from the giant *Cereus* to the various forms of flat-branched and cylindrical *Opuntias*, intermixed with *Mamillarias* and *Echinocacti* in great number. *Cereus giganteus*, or the tree cactus, attains a height of from twenty to fifty feet, and is probably half a

century in attaining its maximum size. It is sometimes entirely unbranched, but often with a few, two or three, or even up to nine branches, which, almost immediately after leaving the trunk, turn upward and grow parallel with the main stem, presenting sometimes the appearance of an immense candelabrum. The trunk of the older trees is often two feet in diameter. It begins to flower when ten to twelve feet high. The flowers are borne near the summit of the stem and branches, and are succeeded by a roundish or pear-shaped fleshy fruit two to three inches long by one and one-half to two inches thick. The interior of this fruit is of a crimson color when ripe, of the consistency of a fig, and of a sweet, but rather insipid taste. They are eaten by the Indians of the country, who reach and detach them by means of a long pointed reed. *Cereus Thurberi* is a smaller species, found in southern Arizona and thence into Mexico. It grows in clusters of five to ten stems from one root, and rises to the height of ten or fifteen feet. The fruit is said to be delicious. Many genera of *Compositæ* have a great development in the desert region. In the sandy arroyos there occur several species of *Baccharis*, together with the well-known Indian arrow-wood, *Pluchea borealis*. Other genera are *Brickellia*, *Aplopappus*, *Bigelovia*, *Verbesina*, *Riddellia*, *Pectis*, *Tagetes*, *Artemisia*, *Perezia*, *Lygodesmia*, etc. Many species, also, of *Convolvulaceæ*, *Solanaceæ* and *Scophulariaceæ* are conspicuous. A *Bignoniaceous* shrub (*Chilopsis saligna*), with handsome corymbs of flowers, sometimes enlivens the dreary stretches of land, especially in the vicinity of water, and, on account of its narrow, willow-like leaves, is known as the desert willow. The orders *Amarantaceæ*, *Chenopodiaceæ* and *Euphorbiaceæ* are represented by many species. Next the *Cactaceæ*, the most striking features of the vegetation are the various species of *Agave* and *Yucca*. *Yucca baccata* usually has a short stem, but in the southwest it sometimes develops a trunk eight or ten feet high covered with refracted dead leaves, and bearing at the apex a large panicle of lily-like white flowers, which are succeeded by an indehiscent, fleshy pod; these are eaten by both whites and Indians, and cured by the Indians for winter food. They also stew the flower buds and flowers, which are said to be nutritious. *Yucca brevifolia* makes a tree from fifteen to thirty feet high, with rough barked trunk one to two feet thick, dividing into a number of branches, each of which is terminated by a close tuft of thick, stiff leaves six to ten inches

long, and below covered with older dead and reflexed leaves. This species was some years ago largely collected and manufactured into paper and paper pulp. It forms, in some places, quite extensive scattered forests, which have a very peculiar appearance. The narrow-leaved *Yucca* (*Y. elata*) occurs on dry hills and ridges, has a trunk three to ten feet high, with extremely narrow leaves one foot to eighteen inches long, and throws up a narrow panicle as long as the trunk. It is one of the most stately of *Yuccas*. *Yucca Whipplei* is abundant in Southern California, extending eastward into Arizona. It has a short trunk, with leaves ten to twenty inches long, and sends up a lower scape to the height of from four to twelve feet, bearing a densely flowered, narrow panicle of greenish-white flowers, which are succeeded by capsules one to two inches long. The leaves furnish a coarse fiber which is used for stuffing saddles and similar purposes.

In the desert region several species of the genus *Agave* are conspicuous, among which are *Agave Schottii*, *Agave Utahensis*, *Agave Newberryi*, *Agave deserti*, *Agave Parryi*, *Agave Palmeri*, and, in the southwest corner of California, *Agave Shawii*. The *Agaves* are chiefly stemless plants with a mass of large, stiff and pulpy leaves crowded together at the surface of the ground, which leaves are generally armed on the margins with coarse, spiny-tipped teeth. There is said to be over 120 species of this genus in Mexico, one of which, called the maguey plant, is of immense importance in furnishing that universal Mexican beverage called pulque. In the vicinity of Mexican cities immense plantations are given up to the cultivation of the plant. At the proper time the crown of the plant is cut out and an excavation made, in which a stream of juice continually flows, and is collected daily by a man who is called a pulquello, going through the fields with a leathern sack on his back into which he pours the pulque fluid, which he takes from the excavations with a dipper. This fluid, after fermentation, forms the beverage above named, which is in universal use among the Mexicans.

A striking feature of some of the dry, sheltered cañons of western Arizona and southern California is the American palm, *Washingtonia filifera*. It attains a height of thirty or forty feet, with a cylindrical trunk two to three feet in diameter, crowned at the top with rather a close tuft of much divided leaves, whose margins are ornamented with loose,

hanging threads. This palm is now cultivated for ornament in many places in California, and has also been introduced into green-house culture in Europe. An attempt has been made at one place in southern California to utilize a portion of the rough barrens country for an ostrich farm. Ostriches have been introduced from Africa, and are kept in large inclosed tracts, where they have abundant freedom. The climate seems to be quite agreeable to them, and their culture promises success.

Washington, D. C.

The stem of *Ephedra*.¹

WALTER H. EVANS.

(WITH PLATE XXI.)

According to Bentham and Hooker, *Ephedra* occupies an intermediate position between *Welwitschia* and *Gnetum* in the order Gnetaceæ. Holding thus a low rank among Gymnosperms, we would expect interesting anatomical structures. In all there are about thirty species, most of which are tropical. Within the United States five or six species have been found, and their range is from Ft. Bridger, Wyoming territory, Colorado and Texas, through Utah, Nevada and Arizona to California.

In this study I used the *Ephedra Nevadensis* Wats. and compared with it *E. aspersa* Engelm., *E. pedunculata* Engelm., *E. vulgaris* Rich., *E. trifurca* Torr., and *E. monostachya* L., all of which seemed to differ in no important detail from the type used.

To the casual observer the stem of *Ephedra* seems to be a jointed affair, branching variously and attaining a height of from six inches to as many feet. He is struck with the close resemblance which the young branches bear to the common horse-tail rush. The stem bears no leaves, but at the nodes of the young shoots are two or three scale-like bracts one to six lines long and usually of a brownish color. In the cases observed, all these scales were deciduous after the first year's growth, while in some cases they were not retained throughout the growing season. These scales are, in all probability, rudimentary leaves, yet they do no leaf work, have no fibro-vascular connection with the stem, and

¹Contribution from the botanical laboratory of Wabash College.